DRISI

Caltrans Division of Research,
Innovation and System Information

Caltrans

RESEARCH CONNECTION

Consumer Valuation of Zero Emission Vehicles:

Private Actions and Social Movements

DRISI

WELCOME

Agenda

Topic	Presenter
Welcome and Housekeeping	Linda Jones
Opening Remarks and Introduction	Joe Horton
Presentation – Consumer Valuation of Zero-Emission Vehicles: Private and Social Movements	Ken Kurani
Q & A	Ken Kurani
Closing Remarks	La Keda Huckabay

Facilities and Evacuation

- **Restroom Locations**
  - Women's
  - Men's
- **Evacuation Information**
  - Emergency Exit Locations
  - Lawn of Capitol Building

Email Question to

research.connection.event@dot.ca.gov

Opening Remarks

Joe Horton
Acting Division Chief

Caltrans Division of Research,
Innovation and System Information (DRISI)

Presenter

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University of California, Davis (ITS–Davis)

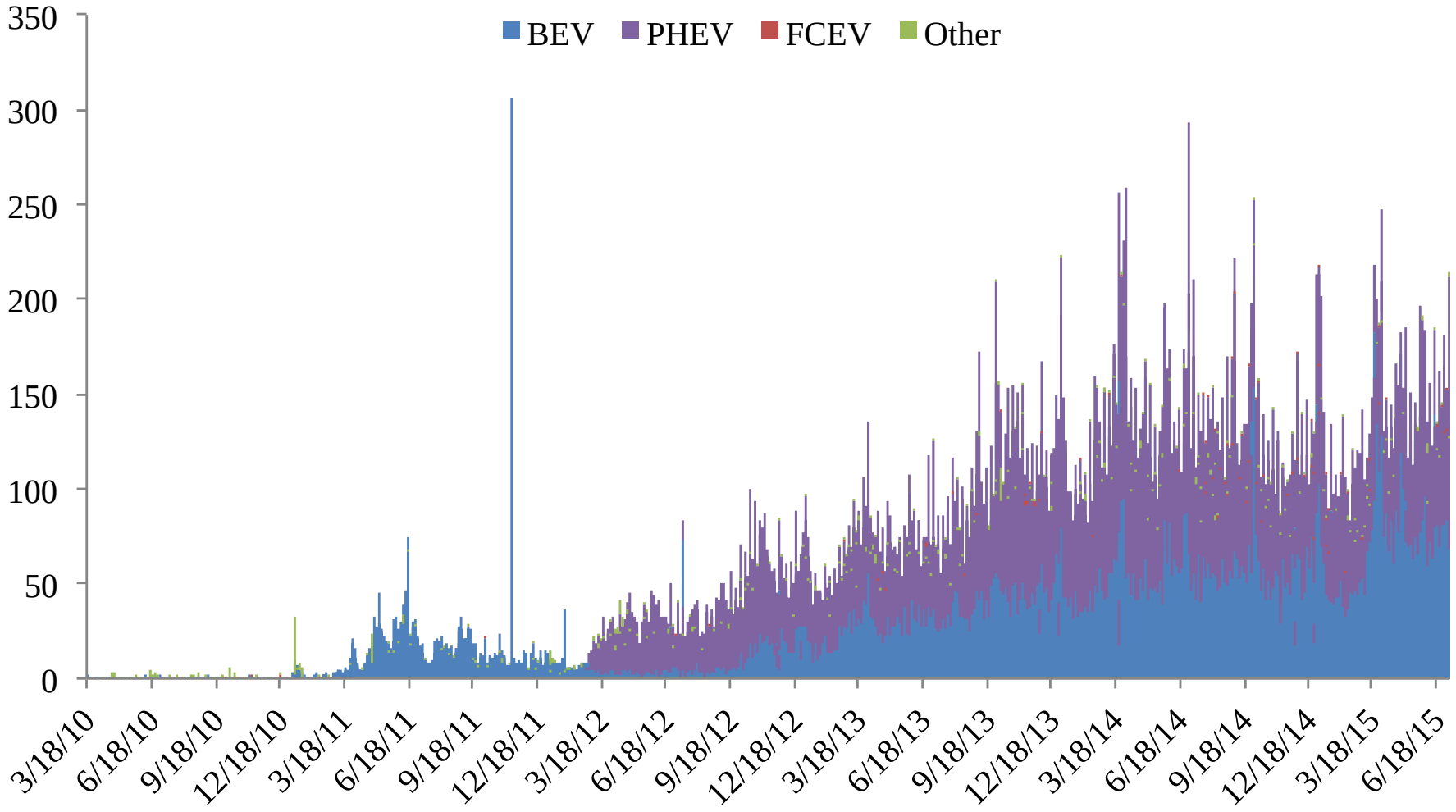
Glossary

Name	Acronym	Definition
Plug-in hybrid electric vehicle	PHEV	A vehicle powered by both an electric motor and a heat engine and carrying energy storage for both. PHEVs may be considered to be ZEV-enabling (see below).
Electric vehicle	EV or BEV	A vehicle powered only by an electric motor; stores electricity in a battery.
Plug-in vehicle	PEV	PHEVs and EVs
Fuel cell vehicle	FCV	A vehicle powered only be an electric motor; stores energy as hydrogen.
Zero-emission Vehicle	ZEV	Statutory definition for vehicles with zero on-road emissions. At present, EVs and FCVs are ZEVs.
ZEV-enabling		Vehicle technologies whose development advances ZEV technology, even if on-road emissions are not zero

Topics for today

1. Information flow between early PEV drivers and use of social media
2. Information between early PEV drivers and drivers of non-PEVs
3. Is the PEV market at (or before) initial awareness?

Weekly California CVRs Issued



Total CVRs issued to 7/7/15: 111,420. Total amount: $235,614,374

PEVs, Social Media, and Community

Research Questions

- Does the confluence of social media and emerging PEV markets facilitate the formation of new interest-based communities among PEV buyers?
- More generally, how are PEV drivers using social media?

Interview Design

- Open ended, semi-structured in-home interviews PEV buyers in San Diego, CA; Spring 2012
  - Who are PEV drivers?
  - Are there PEV communities?
  - Listen for social interaction:
    - use of social media; meet-ups and gatherings; informal social interaction

Conclusions

Social Media

- Offer early PEV drivers a means to construct an interest-based community
- Makes access to this community easier for potential PEV buyers
- Offers PEV drivers a medium for interacting with vehicle manufacturers and dealerships
- Offers policymakers and PEV stakeholders ways to expand the PEV market
- Provides potential PEV buyers with an essential resource of practical knowledge
  - PEVs
  - User opinions and experiences
  - User norms and behaviors, e.g., charging etiquette

Do You Mind if I Plug-in My Car?

- PEV drivers want widely shared, understood, and practiced charging etiquette
  - Rules and other guidelines to feel comfortable and confident in charging away-from-home.
  - They want to be certain of what to expect and know how to act in different charging situations.
  - A lack of shared and practiced rules inhibits use of away-from-home charging.
- New expectations and rules of financial transactions open etiquette to a new round of uncertainty about the rules

Accounting for PEVs:

Encounters between PEV drivers and non-PEV drivers

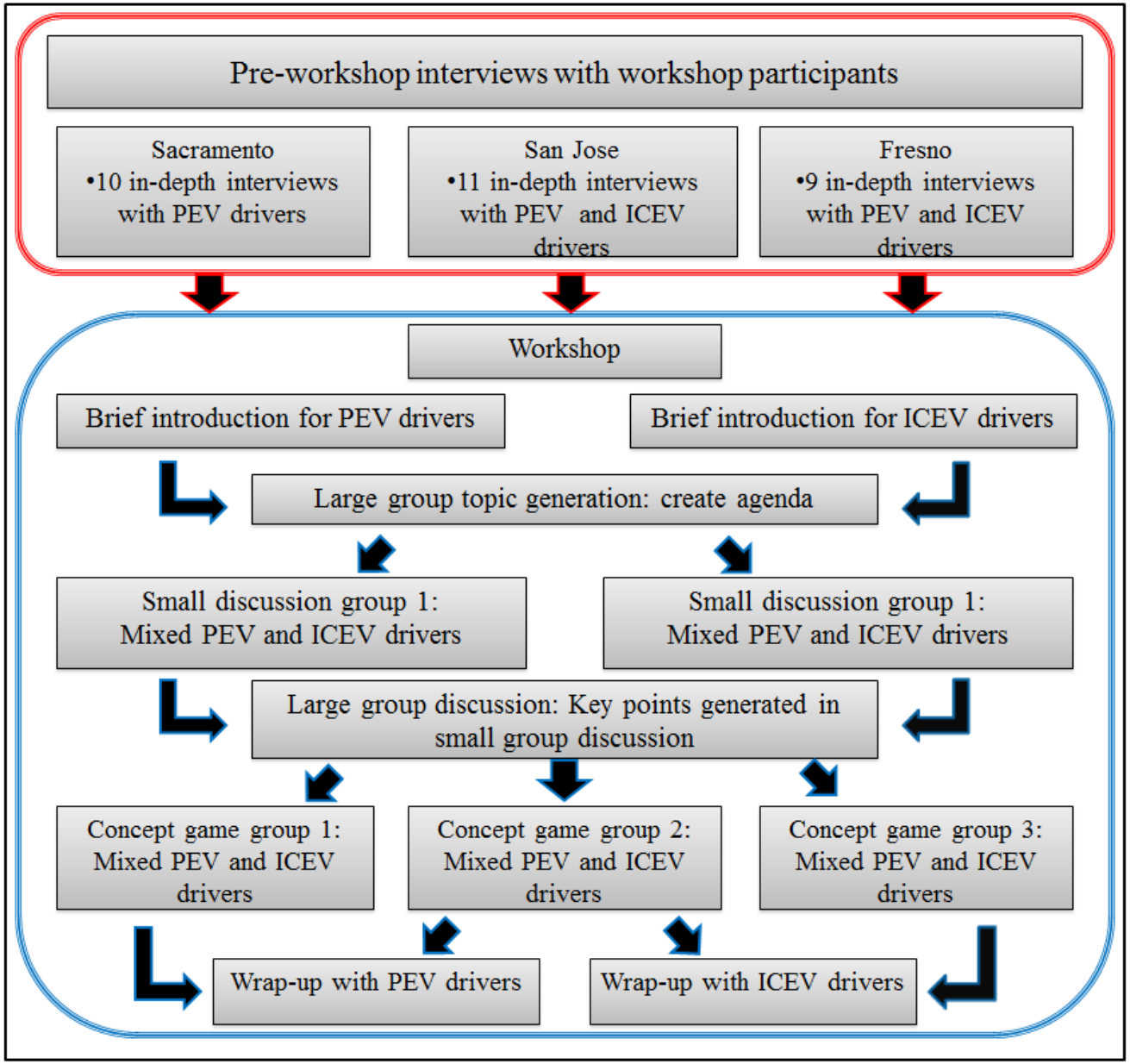
Study design

- Household interviews and workshops in three distinct regions of California
- New Car Buyers
  - PEV owners
  - Matching group (on income, age, education, but not gender) who are not PEV owners
- One-on-one interviews to understand each household's context
  - Vehicle purchase history, vehicle use, life stage,…
- Workshop in each city combined both groups
  - A constructed social setting to observe information flow between existing PEV owners to potential later ones.

Interviews

- PEV driver interviews
  - Purchase and use of PEV
  - Possible changes to PEV charging infrastructure; home and away-from-home
  - Attention to Social Interactions
    - PEV purchase process
    - With people who don't own PEVs
- ICEV driver interviews
  - Household vehicle history
    - Conditions and situations they acquired their vehicles
  - No discussion of PEVs
    - Partly by design, but mostly because in conversations about cars, people who don't already own a PEV don't mention them

Research Flow



The Study Regions

	"Fresno"	"Sacramento"	"San Jose"	California
PEV/1000 people	**0.49**	**0.97**	**5.54**	**1.80**
Public Level 2 and Quick charge infrastructure: locations	Level 2: **5 locations** Quick charge: **0 locations**	Level 2: **74 locations** Quick charge: **4 locations**	Level 2: **142 locations** Quick charge: **18 locations**	Level 2: 1,703 locations Quick charge: 162 locations
Median income, 2008-2012	**$45,741**	$55,846	**$90,747**	State: $61,400
Bachelor's degree or higher, % of persons age 25+, 2008-2012	**19.4** CVR recipients: **71**	27.9 CVR recipients: **81**	**46.0** CVR recipients: **90**	State: 30.5 CVR recipients: 83
Homeownership, 2008-2012, %	**54.2** CVR recipients: **92**	57.6 CVR recipients: 93	58.1 CVR recipients: 89	State: 56.0 CVR recipients: 87
Female, %	**50.0** CVR recipients: **23**	51.1 CVR recipients: 24	49.7 CVR recipients: 24	State: 50.3 CVR recipients: 24

PEV, charger, and CVR data are as of Spring 2014.

PEV Incentives

	California	"Fresno"	"Sacramento"	"San Jose"
	1. Federal income tax credit: $2,500 to $7,500 2. California Clean Vehicle Rebate: $1,500 (PHEV) or $2,500 (EV) 3. California HOV lane access for single occupant vehicles	California, plus: San Joaquin Valley Air Pollution Control District PEV purchase rebate: $2,000 (PHEV) or $3,000 (EV)	California, plus: City of Sacramento: Free parking and charging in a city-operated parking garage downtown. Parking: $200 per month Charging: variable	California, plus: Home EVSE purchase and installation rebate: up to $1,500. (Available during the period these PEV owners acquired their PEVs. This program is now over.)
HOV definition			2 or more people	3 or more people
HOV lane miles	1,552.7	0	69.8	174.9

The Samples

- PEV drivers sampled for maximum variety
  - Type of PEV, income, age, gender, children in the home or not, employment status,
  - Sacramento only
    - Whether they commuted in their PEV to downtown Sacramento
    - Whether or not they had a home charger
- ICEV drivers similar, as a group, to the sample of PEV drivers in the same city/region
- All three cities, balanced on:
  - Number of PEV and ICEV households
  - Women and men
  - Children in the home or not
  - Age 20's to 60-70's

PEV owner vehicles

- 20 EVs
  - Mitsubishi i-MiEV, Fiat 500E, Ford Focus EV, Nissan Leaf, Toyota RAV4EV, and Tesla S
    - Span then available spectrum of price, performance, luxury, driving range, and charging power
- 10 PHEVs
  - Honda Accord Plug-in, Toyota Prius Plug-in, and Chevrolet Volt
    - More nearly similar to each other than the EVs: kost pertinent difference is “electric driving range”

Workshop: Agenda creation

- Introduced to PEVs and PEV drivers, what do ICEV drivers want to talk about?
  - Purchase costs; benefits of driving a PEV
  - No questions about incentives as they didn't know any were available
  - Few questions about charging infrastructure
- Both incentives and infrastructure had to be introduced by PEV drivers

PEV drivers respond

- Accounts of saving money
  - Incentives and rebates
  - Free public charging
  - The cost of electricity is less than the cost of gasoline
    - *Zoe (PEV, Fresno) said, "The math is cuckoo crazy."*
    - *Trent (PEV, Fresno) explained, "It was solely a financial decision…we did the math and I can own and operate that [PEV] for about 90 bucks a month…we're saving hundreds of dollars a month."*

PEV drivers respond

- Social benefits
  - Reducing air pollution
  - Reducing dependence on foreign oil
  - Some separate their motivations from those who claim environmental motivations
    - *Elizabeth (PEV): After I got it…one of my kids has mild asthma…so I was like, "Oh, I'm not contributing to his asthma, one less car on the road.*
    - *Jessica (PEV) said, "My impression was it's more the 'go green' people that drive these cars, but I'm not one of them…I'm not this huge tree hugger either. I'm very far from being liberal."*

Listening to awareness take shape…

- ICEV drivers were almost completely unaware of PEV charging and infrastructure
- PEV drivers were prompted to explain
  - How they charge their PEV
  - Locations and cost of chargers
- ICEV drivers responded with more questions
  - Home charger requirements
  - Running out of charge,
  - Solar to charge a PEV
  - Finding charger locations outside their region

Findings

- Despite living in the same geographic region, PEV and ICEV drivers experience a different landscape
  - PEV drivers see PEVs and signs of them everywhere; ICEV drivers don't see them anywhere
    - Sam (ICEV, Fresno):"I haven't seen one [PEV charger]. And believe me I drive around. Believe me, about 200 miles a day in this town. I haven't see one station. Yet, I haven't been looking. But I haven't seen one sign that says 'EV station here.' Or anything like this. Where are they?"
  - Some San Jose ICEV drivers were aware of HOV lane access—but don't know what vehicles qualify

Conclusions

- For PEVs, communications hypothesized to be essential between early actors and potential later actors are not yet pervasive—or even particularly active.
- PEV owners “accounts”—partial and informal balances of costs and benefits conveyed in stories about how they came to be a PEV owner and about life with a PEV.
  - The basic signs of the existence of PEVs and incentives are quickly conveyed.
  - PEV drivers portray themselves as having made a financially sensible purchase; re-positions what PEVs mean to the ICEV owners:
    - PEVs are not (only) for “environmental wackos” but for people who want to save money.
  - The sustainability of public spending on PEV purchase incentives to afford this meaning is another question raised by ICEV drivers
    - Will those incentives still be there if and when they consider a PEV?

Conclusions

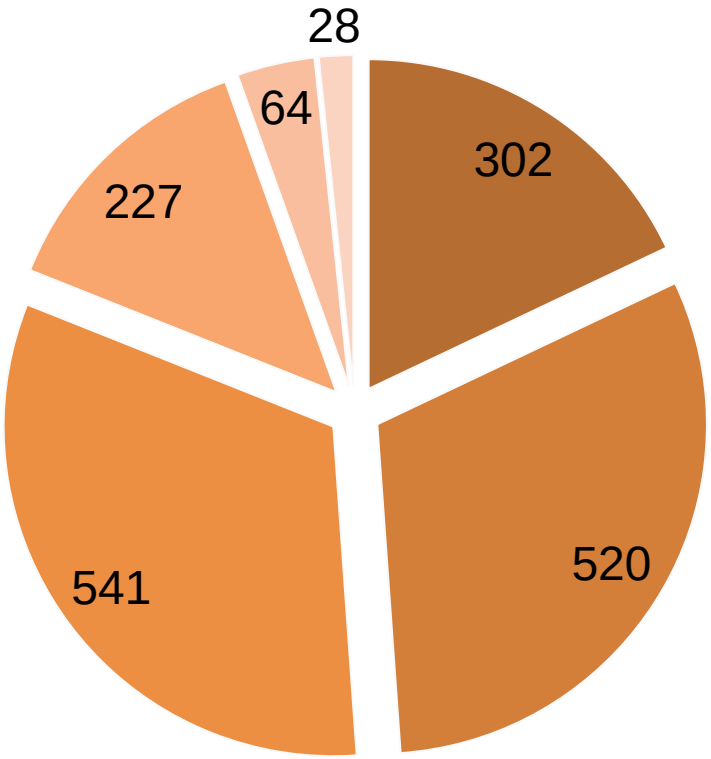
- Therefore, as constructed and told in the workshops, accounts for PEVs are fragile.
  - Policy, in the form of large financial incentives, contributes to this fragility.
  - If policy changes, if those large financial incentives are taken away, the accounts told by PEV drivers in the workshops fall apart.
  - Why would anyone buy of PEV if there are no incentives? What other account would they give and under what conditions?

Consumer Valuation of ZEVs

- Study 1
  - Survey: CA Car owning households; June 2014; n = 1,681
- Study 2
  - Survey: December 2014 to January 2015
    - Multi-state sample of new car buyer households
    - Results today from California
  - Interviews: January to March 2015
    - Participants elected from survey respondents
      - ZEV and non-ZEV results from survey design games
      - Three States
        - » Oregon (Portland)
        - » Washington (Puget Sound)
        - » California (Sacramento, South San Francisco Bay Area, San Diego, Los Angeles)

Seeing PEVs?

Have you considered buying a vehicle that runs on electricity for your household?

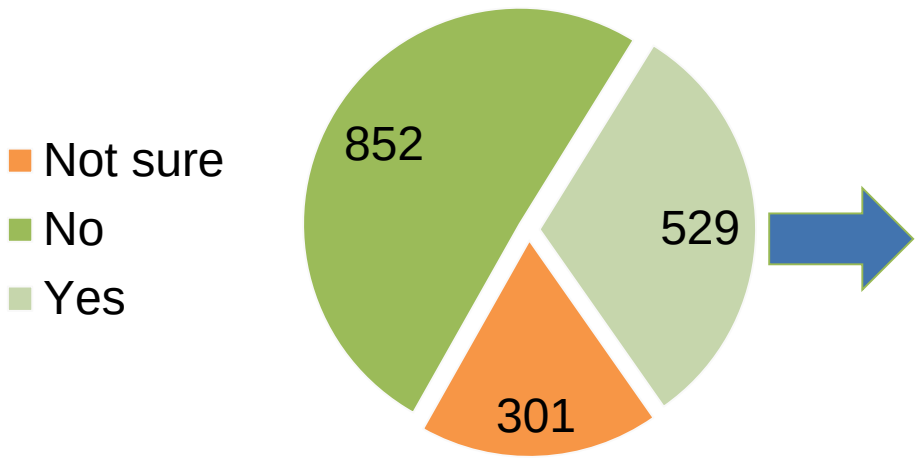


- …have not and would not…
- …have not …but maybe some day we will
- …idea has occurred, but no real steps have been taken…
- …gathered information, but haven't really gotten serious
- …shopped for one, visited a dealership...
- ...already have a vehicle powered by electricity

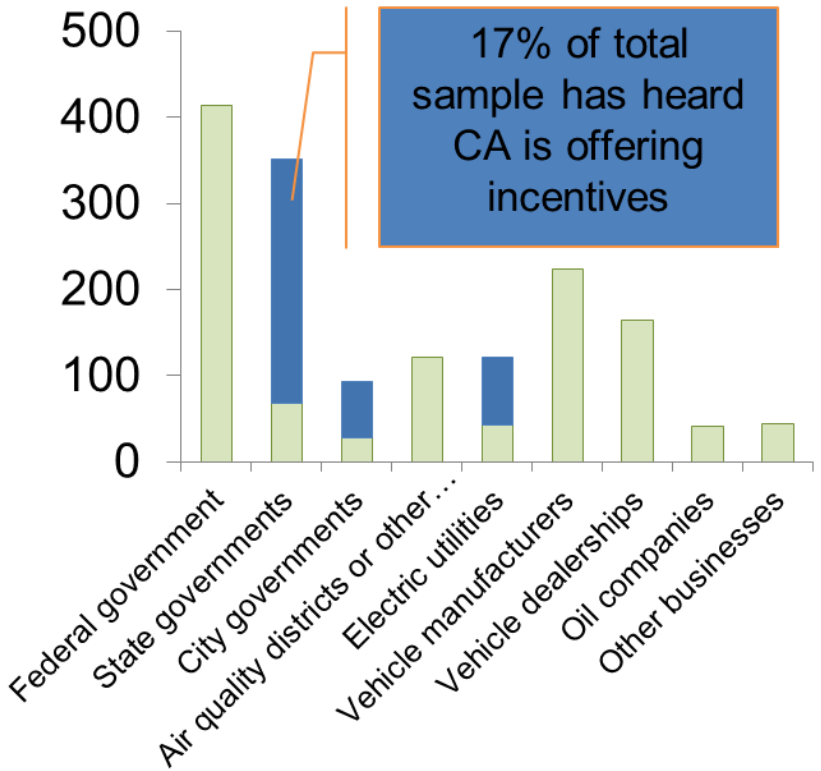
CA Car owning households; June 2014

There are incentives for vehicles that don't run on gasoline or diesel?

"Have you heard incentives are being offered to consumers to buy vehicles that don't run on gasoline or diesel?"

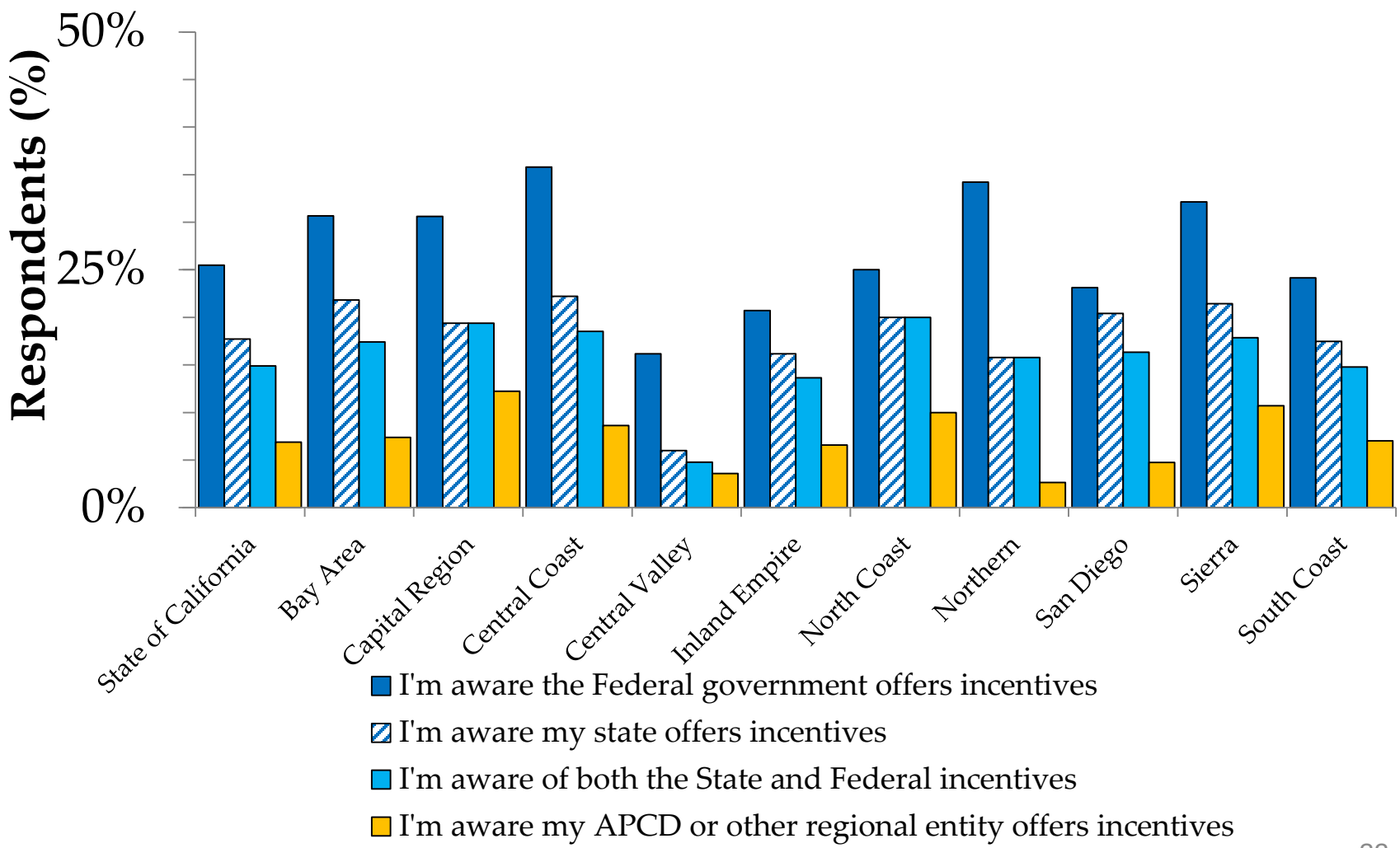


Of those 529 (31%) who say "Yes," how many have heard of incentives from each of these other sources?



CA Car owning households; June 2014

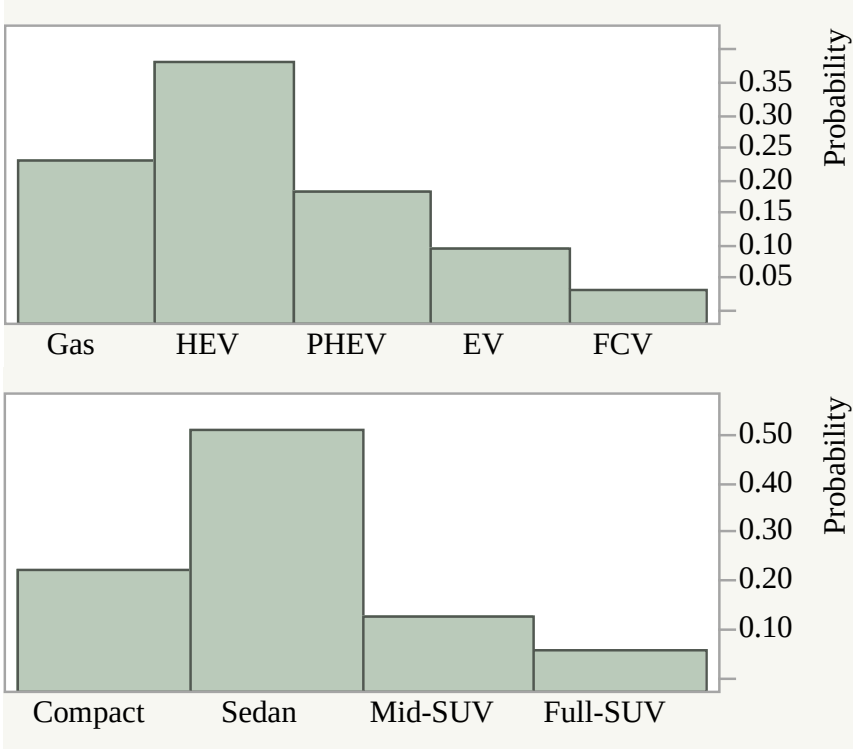
Do higher incentives create higher awareness of incentives?



Do people design their next new vehicle to be a ZEV?

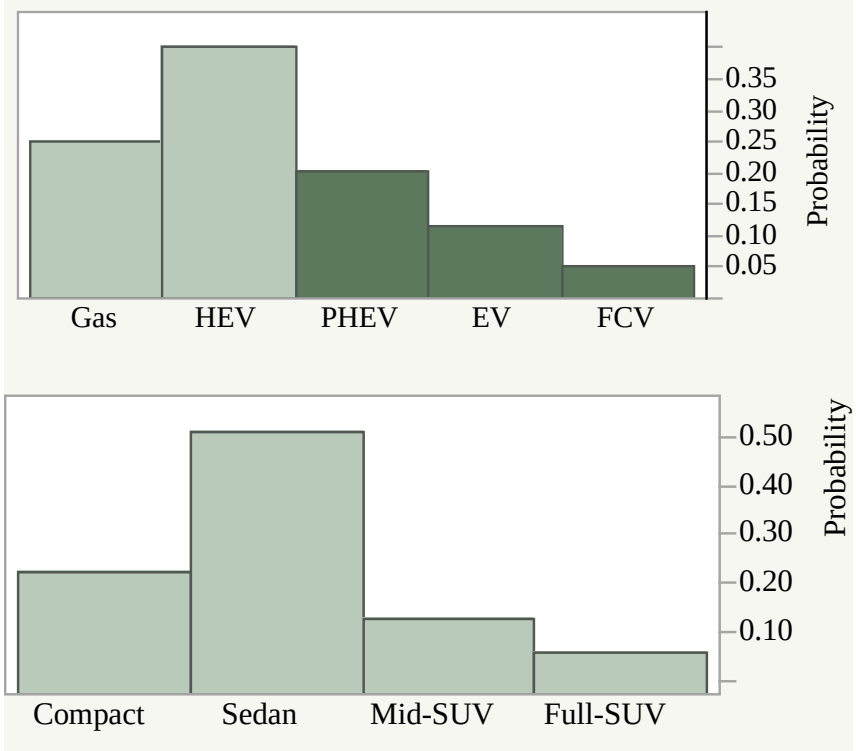
Game 1:

All-body styles allowed as ZEVs



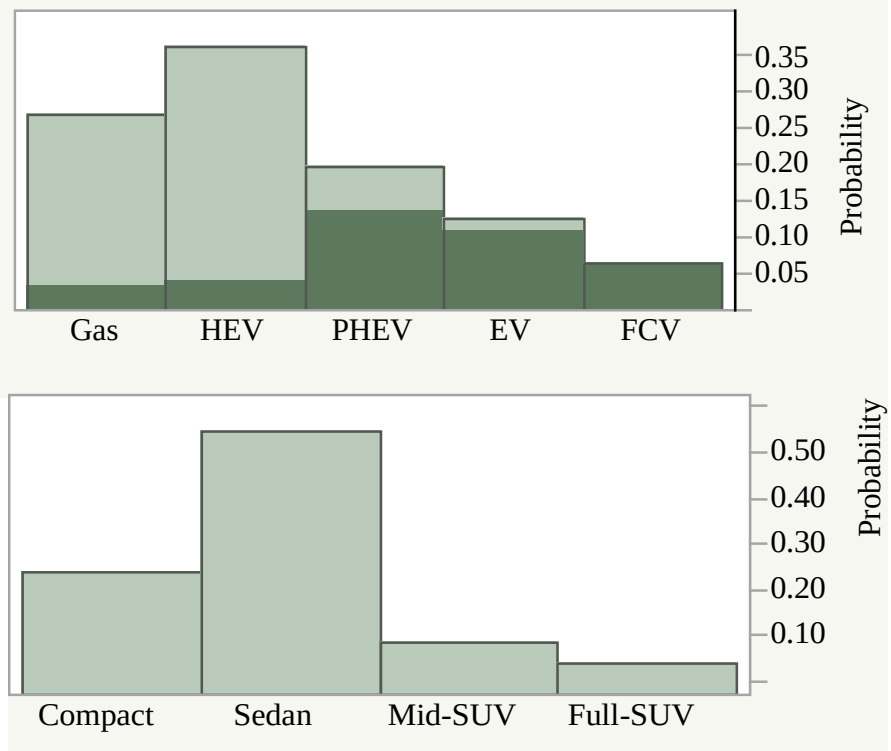
Drivetrain and body style-size designs, CA

Game 1:
All-body styles allowed as ZEVs



n = 2,392

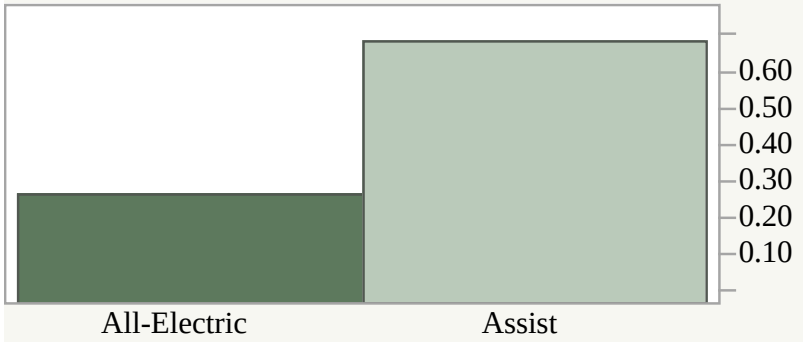
Game 3:
No ZEV "trucks"; w/incentives

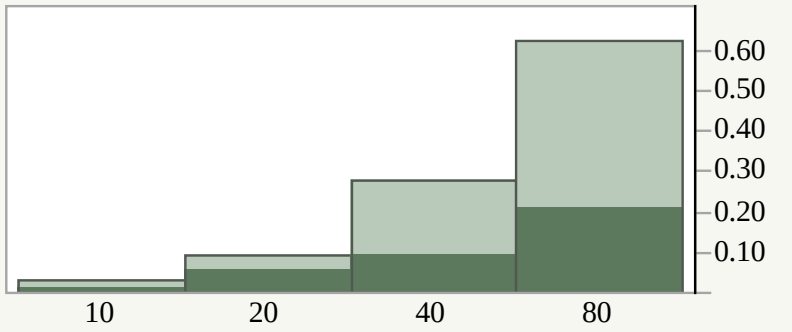


n = 2,390

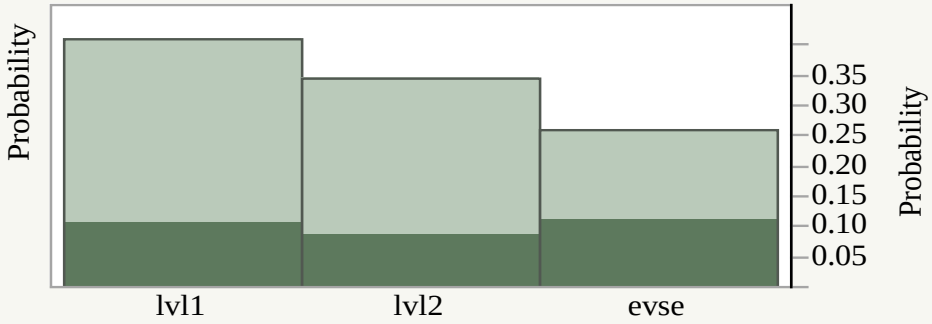
PHEV Designs: Game 3
No trucks, plus incentives, n = 464

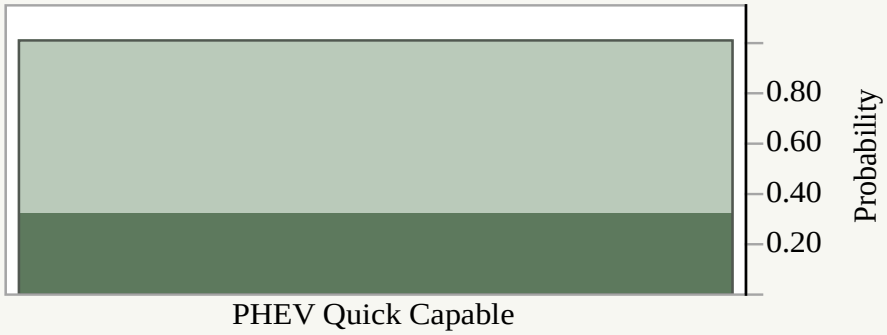
Charge depleting mode and range





Home charging and quick charge capability

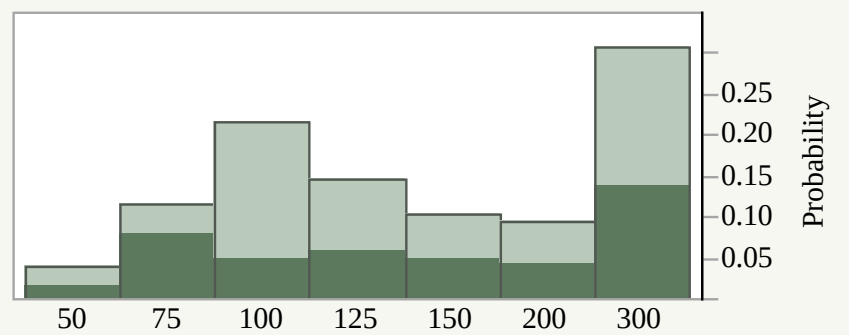


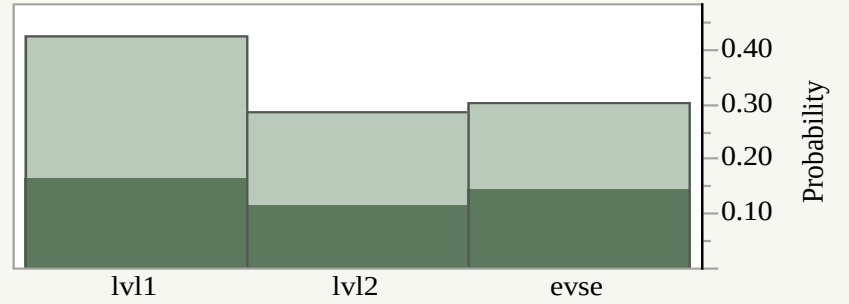


n = 209; 45% of all PHEV designs

EV (n = 293) and FCV (n = 144) Designs: No trucks, plus incentives

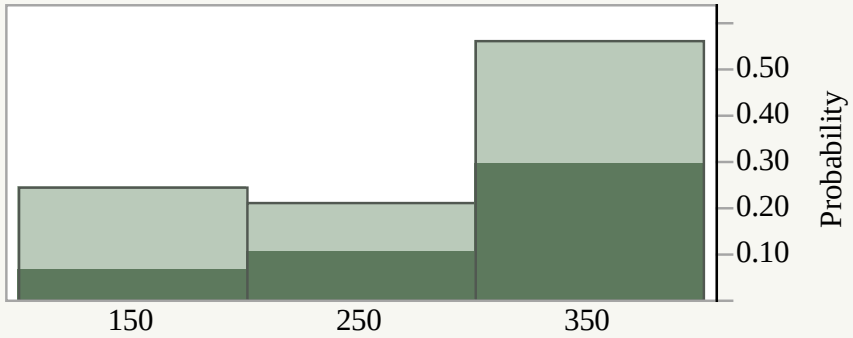
EV: Range and charging





Dark shade: Quick charge capable
n = 118; 69% of all EV designs

FCV: Range and home fueling

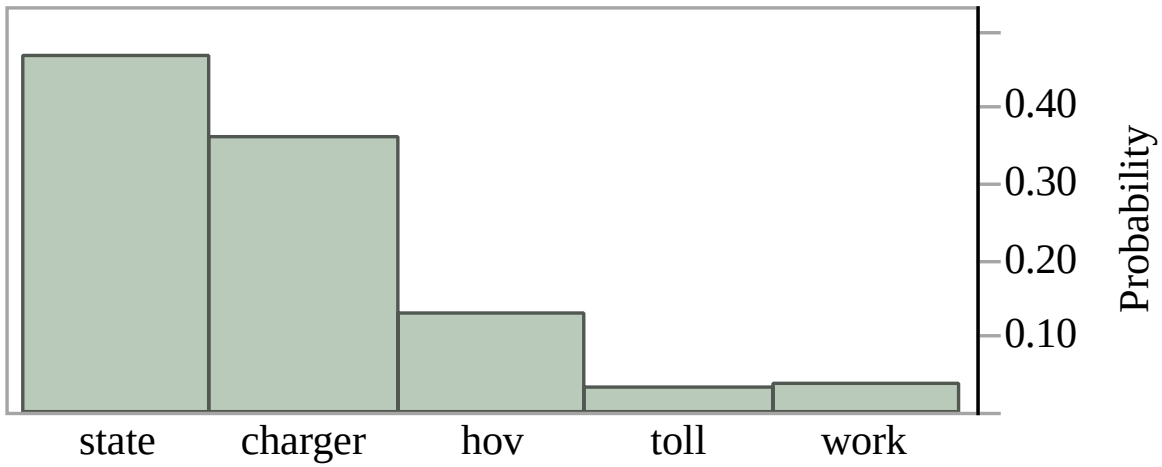


Dark shade: Home hydrogen fueling
N = 63; 57% of all FCV designs

Incentives

- All PHEVs, EVs, and FCVs eligible for federal tax credit
  - Amounts equal to present federal schedule
- Plus their choice of **one** of the following incentives
  - State vehicle incentive
    - Amounts equal to CA's current schedule
  - State home charger/H2 fueling incentive
    - PHEV/EV charger incentive equal to State vehicle incentive
  - Single occupant HOV access (until Jan. 2019)
  - Reduced bridge and road tolls (until Jan. 2019)
  - If workplace charging isn't available to them, imagine it is (not offered for FCVs)

Incentives



Frequencies

Level	Count	Prob
state	252	0.46239
charger	193	0.35413
hov	68	0.12477
toll	14	0.02569
work	18	0.03303
Total	545	1.00000

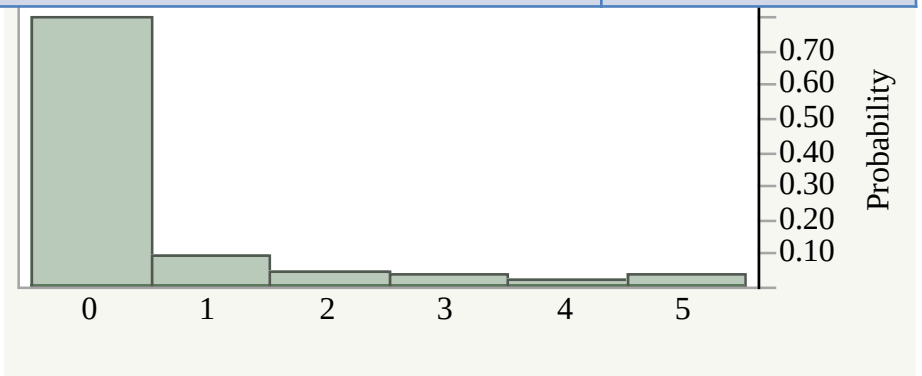
N Missing 1126

5 Levels

Why don't people design their next new vehicle to be a PHEV, EV, or FCV?

Limited number of places to charge or fuel away from home	**2.6**
Cost of vehicle purchase	2.1
Electric driving range	1.8
I'm unfamiliar with the vehicle technologies	1.8
Concern about unreliable electricity, e.g. blackouts and overall supply	1.5
Concern about time needed to charge or fuel vehicle	1.4
I was tempted; higher incentives would have convinced me.	0.5

0 to 5 pts. per item; mean number of pts. = 1.02



Survey Respondent Interviews

Sample: City; Body style/size; ZEV-interest

55 Households

- Seattle
- Portland
- Sacramento
- Los Angeles
- San Diego
- South and East SF Bay Area

Compact ZEV	Full Size ZEV
Compact non-ZEV	Full Size non-ZEV

Goals for the Interviews

- Understand the motivations behind participants' survey answers
- Collect detailed household retrospectives of vehicle purchases
- Allow households to imagine owning a ZEV
- Listen for lack of knowledge and motivation vs. actual opposition

Those Who Cannot Imagine Owning a PEV

Barriers

- Too many unknowns
  - (Perceived) availability, purchase cost, cost and time to charge, lack of range, battery replacement, needing to plan charging, no or limited places to charge/refuel
- Not green
  - Battery disposal, electricity production
- Don't want to be a guinea pig
- Safety concerns
  - FCVs: "It sounds kind of scary. When I think of hydrogen I think of very explosive. So, if you get hit by another vehicle, are you just going to go 'Whoosh!'"

Motivations

- Save money on gas, not going to the gas station, cool factor, being a part of the future
  - "That's where I think the industry is going. I think anyone who is buying a conventional or gas car these days is not very far sighted."
- Would rather try a PHEV first
  - "I would rather try a plug-in hybrid first and then see how comfortable I was with it and how it worked. And then maybe move into an electric car after that."
- FCV appealing environmentally because emission is water

The Lure and Lore of Tesla

In a league of its own

- “I’ve looked into Tesla, which is top of the line. It’s very expensive, incredibly reliable. It’s got great reviews. I think what they’ve done is amazing. I’m really in awe of the owner of the company. I think he’s done a wonderful service to the economy, to our environment, and whatever.”

Knowledge of Tesla

- What they know
  - Superchargers
  - Expensive
  - Long range
  - Cool
  - Elon Musk
- What they want to know
  - Cost to purchase
  - How they work

The Future of Cars

Are PEVs the future?

- Yes
  - "If we're headed in the direction I think we're headed in the future with vehicles…we're eventually going to have electric vehicles everywhere."
- No
  - "The short range vehicle is useless because you're too busy charging it."

When is the future?

- Now
  - "It's already becoming normal…I think we've passed that hump so to speak."
- 5-6 years from now
- They don't know when, but they know it isn't now

Preliminary take-away messages

- As with prior surveys (2008, 2010, 2012), a “high” percentage of new-car buyers are interested in ZEVs and ZEV-enabling technology
- Incentives don’t pull many full-size vehicle designers away from large vehicles
  - Required to choose, 82% of those who initially designed a full-size vehicle with all-electric drive stay with full-size rather than all-electric

Preliminary take-away messages

- Given a choice between incentives, additional financial incentives from the State are by far most frequently chosen
  - However, people seem to care what the money is for
- Choice of additional incentive may not differ between those who design their next new vehicle to be a PHEV, EV, or FCV.

Preliminary take-away messages

- Motivations for and against PEVs and FCVs reflect much of what was elaborated in the interviews
- (Increased) incentives appear to have little effect on (and on a very few of) those who don't already design their next new vehicle to be a PEV or FCV
  - 2.5%

Where do we go from here?

- The first impediment to larger markets for ZEVs may not be what people think about them, but that they haven't thought about them
- Having started by giving financial incentives, we likely must continue
- Social marketing of the idea of ZEVs and their social benefits

Q & A

Closing Remarks

La Keda Huckabay
Office Chief

DRISI Planning, Policy and Program Development